CALIFORNIA
OCCUPATIONAL GUIDES

EDD Employment Development Department
State of California

MICROBIOLOGISTS

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INTEREST AREA
INVESTIGATIVE

WHAT DOES A MICROBIOLOGIST DO?

MICROBIOLOGISTS study bacteria and other microorganisms to better understand their relation to human, plant, and animal health. By learning as much as possible about these organism's life, behavior, growth and death, they add to human knowledge about the genetic foundations of all life on the planet.

A key function of Microbiologists is to better utilize microbial life in the manufacture of vitamins, antibiotics, amino acids, alcohols, sugars and other products. The fermentation of wine, for instance, depends upon the hard work of tiny yeast cells that live on the sugar of grapes, changing that sugar into alcohol. Without these busy unseen fungi, grapes would yield little more than grape juice.

Scientists thus far have identified only one to two percent of Earth's microbial life, so many new species remain to be discovered. New species are studied as to how they live, behave, interact with other organisms, and reproduce. These undiscovered and unstudied microbes might be the source of new antibiotics and other drugs, as well as a deeper understanding of life itself.

Microbiologists perform the following tasks:

- Study growth, structure, development, and general characteristics of bacteria and other microorganisms to understand their relationship to human, plant, and animal health.
- Examine physiological, morphological, and cultural characteristics, using microscope, to identify and classify microorganisms in human, water, and food specimens.
- Observe action of microorganisms upon living tissues of plants, higher animals, and other microorganisms, and on dead organic matter.
- Isolate and make cultures of bacteria or other microorganisms in prescribed media, controlling moisture, aeration, temperature, and nutrition.
- Conduct chemical analyses of substances, such as acids, alcohols, and enzymes.
- Research use of bacteria and microorganisms to develop vitamins, antibiotics, amino acids, grain alcohol, sugars, and polymers.
- Prepare technical reports and recommendations based upon research outcomes.
- Study the structure and function of human, animal and plant tissues, cells, pathogens and toxins.

The nature of the work may vary considerably with the assignments. Some Microbiologists deal with specific kinds of microorganisms such as fungi, algae, viruses, and microparasites. Others are concerned with specific fields or areas of work such as immunology, serology, virology, physiology, genetics, taxonomy, and cytology.

Microbiologists use a variety of instruments in their work, such as electron microscopes and other complex laboratory equipment. Some Microbiologists train and supervise other personnel, keep records, and prepare reports. The majority of Microbiologists are classified by the specific activity they perform.

The following are some of the more common types of Microbiologists:

Medical or Veterinary Microbiologists

These specialists work with physicians, dentists, and medical researchers to study the interactions between microorganisms and humans to determine how and why diseases occur.

Clinical Microbiologists

These workers perform laboratory tests to provide physicians with information needed for diagnosis and treatment. Experienced Clinical Microbiologists serve as consultants on diagnosis and technical problems. Clinical Microbiologists are usually employed by hospitals and private clinical laboratories.

Certified Public Health Microbiologists

These workers provide laboratory services for local health departments and community environmental health programs. They are primarily concerned with the control of communicable diseases and other health hazards in the community. This includes isolation and identification of microorganisms in specimens from patients as well as from water supplies, food, and milk.

Environmental Microbiologists

Workers in this specialty test water samples from lakes and streams for biological and chemical pollutants as well as inspect food and water in processing plants. They also help remedy problems identified.

Industrial Microbiologists

Workers in this specialty are concerned with the development of new products and the monitoring of established processes for microbial content. They also teach and develop new methods of preservation for food and pharmaceutical supplies. They may help set quality standards for these products. These professionals may also tend strains of microorganisms which produce alternate sources of energy. Researchers trained in molecular biology investigate genetics and biochemical techniques for creating microorganisms with desired characteristics. Biotechnology is used to advance knowledge of cell reproduction and human disease.

Agricultural Microbiologists

These workers study the effect of microorganisms on soil and agricultural products and the use of microorganisms as agents of insect control. These scientists are concerned with methods to combat crop damage and increase crop yield. They also investigate the nutritional role played by microorganisms found in cattle, sheep, and other ruminants. They investigate the growth, structure, development, and other characteristics of microscopic organisms, such as bacteria, algae, or fungi. They may work closely with medical microbiologists who look for disease-causing bacteria on or in food products.

WHAT SKILLS ARE IMPORTANT?

Important skills, knowledge, and abilities for Microbiologists include:

- Science – Using scientific rules and methods to solve problems.
- Writing – Communicating effectively in writing as appropriate for the needs of the audience.
- Reading Comprehension – Understanding written sentences and paragraphs in work-related documents.
- Critical Thinking – Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

- Active Learning – Understanding the implications of new information for both current and future problem-solving and decision-making.
- Biology – Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
- Mathematics – Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
- Chemistry – Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
- Deductive Reasoning – The ability to apply general rules to specific problems to produce answers that make sense.
- Near Vision – The ability to see details at close range (within a few feet of the observer).
- Inductive Reasoning – The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events).
- Written Comprehension – The ability to read and understand information and ideas presented in writing.
- Information Ordering – The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).

WHAT'S THE WORK ENVIRONMENT?

Microbiologists perform most of their work in comfortable laboratories and offices. Laboratory settings are kept very clean to avoid contamination of cultures and culture media. Research work may also be done in the field, in a variety of environments, and under any weather condition. Normal color vision and good vision (may be corrected) is essential because of extensive use of microscopes and other research instruments.

Precautions must be taken in handling potent chemicals, animals, or disease-producing organisms. However, risks are minimized by using protective clothing, immunization, use of safety equipment, and adherence to safety rules and regulations. Strict adherence to safety protocols is essential when working with very contagious, very deadly microorganisms, such as those which cause AIDS, Ebola, Hantavirus, and other diseases for which cures are difficult or impossible.

Microbiologists may become members of the American Society for Microbiology. Some belong to associations directly related to their industries or specialties.

Union Membership

Clinical Microbiologists who work in a hospital setting may belong to the union. Workers for local or State government may belong to a union.

WHAT'S THE CALIFORNIA JOB OUTLOOK?

The following information is from the occupational projections produced by the Employment Development Department (EDD) Labor Market Information Division (LMID):

Microbiologists	
Estimated number of workers in 2002:	1,600
Estimated number of workers in 2012:	2,200
Projected Growth 2002-2012:	37.5%
Est. openings due to separations by 2012:	500

These figures do not include self-employment.

This occupation will grow faster than average compared with all occupations in California.

There will be an estimated 1,100 job opportunities per year in this occupation during the projections period.

Many factors will continue to contribute to the demand for Microbiologists. Some of these are continuous growth in the population, the aging of the population, and increases in potential health hazards; additional waste water plants and the need for more efficient methods of waste water disposal treatment; increased dependence on products of microbiological research; space

exploration and experimentation; and expansions in the nuclear and chemical industries. Health, food, ecology or environment, energy, and industrial processes are areas that will experience growth. Advances in these areas will result in the need for trained Microbiologists in industry, government, universities, and hospitals. In addition to the new jobs that will become available, many opportunities are expected for the replacement of those who leave the labor market.

Applicants competing for public health and clinical laboratory internships might find competition keen. However, certified and licensed Microbiologists with specialized training and advanced degrees for clinical or diagnostic microbiology will be most in demand.

Trends

Recently, federal government spending for general biological and, especially, medical research, has significantly increased. Congress has set a goal of doubling the budget allocation for the National Institutes of Health, the umbrella organization that oversees most government spending and research in medicine and related fields.

The 2001 terrorist attacks at New York's World Trade Center and the Pentagon, as well as the subsequent anthrax mailings, have underscored the need to put the country on a rapid-response footing to respond to bioterrorist attacks. Biological, chemical or nuclear attacks could be directed at individuals, large populations, or the nation's food or water supply, and put the lives of millions of Americans at risk. Microbiologists would be one of the first lines of defense in biological and chemical attacks. Quick and accurate detection and identification of a suspected bioterror agent is absolutely crucial in alerting government authorities to the danger.

The federal government has adopted policies which will enhance the early response capability of the country, and that means that funding for Microbiologists will increase.

WHAT DOES THE JOB PAY?

California Earnings

The following information is from the Occupational Employment Statistics Survey of Employers by EDD/LMID:

Microbiologists 2005 Wages

Hourly wages range from	$22.58 to $37.74
Average hourly wage	$31.24
Average annual wage	$64,986

These figures do not include self-employment.

Hours

Salaries for Microbiologists are influenced by training, experience, type of employment, responsibilities, and special requirements of the job. Industrial and governmental laboratories pay more than colleges or universities. In general, Microbiologists with graduate degrees earn even higher salaries.

Microbiologists normally work an eight-hour day, 40-hour week schedule. However, some employers such as public health and hospital laboratories require overtime and occasional weekend work. Hospitals and laboratories usually rotate their shifts. Weekend work and long hours may also be necessary during critical periods in the food and wine industries. University and college faculty may work only the number of months required by their contract.

Benefits

Benefits generally include vacations, holidays, sick leave, and health and retirement plans.

HOW DO I PREPARE FOR THE JOB?

Education and Training

The minimum educational requirement for beginning jobs is a baccalaureate degree. However, an associate of arts degree qualifies an

individual to become a laboratory assistant or technician. A master's or doctoral degree is necessary for college teaching, independent research, and administrative jobs. The level of responsibility and type of work performed determines the degree required.

Most four-year colleges in the State offer degree programs in microbiology, biology, or related fields. To locate educational programs for Microbiologists use www.cpec.ca.gov/collegeguide/collegeguide.asp.

Licensing and Certification

In order to do microbiology testing of human samples, Microbiologists must be licensed. Many Microbiologists possess a Clinical Laboratory Scientist license. Others have a limited license as a Clinical Microbiologist Scientist. Both of these licenses are issued by the California Department of Health Services.

Public Health Microbiologists who work for the State of California or in local public health laboratories must posses a valid Public Health Microbiologist Certificate issued by the California Department of Health of Services. Those who test milk for county health departments must obtain a Proficiency Certificate from the Department of Food and Agriculture.

A combination of academic course work and suitable experience in a clinical or public health laboratory is required for an individual to qualify for a public health microbiologist's license. The usual pattern is a degree in one of the clinical laboratory sciences and one year of supervised training or internship in a clinical laboratory, or six months training in an approved public health laboratory. A person qualified academically but without training or experience is eligible for a trainee license. The trainee works under direct supervision and is tested periodically to verify they are learning at an acceptable pace.

Licensure or certification is granted to those who achieve a passing grade on written and oral examinations given by the State Department of Health.

Non-licensed or non-certified personnel may work in federally funded nonprofit laboratories, academic institutions engaged in teaching or research, California licensed community clinics, private physicians' offices, and some departments of State government.

Continuing Education

Continuing education is required for both the Clinical Laboratory Scientist and those with limited microbiology licenses. They are required to complete 12 continuing education units each year.

HOW DO I FIND THE JOB?

Direct employer contact remains one of the most effective job search methods. Most Microbiologists are employed in the services and government industries.

Search these **yellow page** headings for listings of private firms:

- State, city and county government public health departments
- Hospitals
- Research and testing laboratories
- Pharmaceutical companies

The following Internet resources can be helpful to the job search process:

America's Career InfoNet
www.acinet.org

America's Job Bank
www.ajb.dni.us

CalJOBS℠
www.caljobs.ca.gov

Job Search and Resume Writing
www.worksmart.ca.gov/success_tips_menu.html

Local Job Service Offices
www.edd.ca.gov/jsrep/jsloc.htm

Occupational Information Network (O*NET) Online
http://online.onetcenter.org

One-Stop Career Centers List
www.edd.ca.gov/ONE-STOP/pic.htm

For statewide and local projections, wages, employers by county, and other occupational information go to www.labormarketinfo.edd.ca.gov and select *Find an Occupation Profile*.

WHERE CAN THE JOB LEAD?

Microbiologists may begin as trainees and advance to positions of greater responsibility as they acquire more experience and education and the required license and certificate. Promotions in public agencies are competitive and follow civil service procedures. A doctorate degree is required to become director of clinical and public health laboratories. In private industry, Microbiologists advance from laboratory worker to head of quality control, research, or production.

OTHER SOURCES OF INFORMATION

California Department of Health Services
Laboratory Field Services Section
1111 Broadway - 19th Floor
Oakland, CA 94607
(510) 873-6328
www.dhs.cahwnet.gov

American Society for Microbiology
1725 N Street, NW
Washington, DC 20036-2904
(202) 942-9283
www.asm.org

RELATED OCCUPATIONAL GUIDES

Medical and Clinical Lab Technologists	No. 17
Enologists/Wine Makers	No. 257
Environmental Health Specialists	No. 347

OCCUPATIONAL CODE REFERENCES

SOC *(Standard Occupational Classification)*
Microbiologists 19-1022

O*NET *(Occupational Information Network)*
Microbiologists 19-1022.00

OES *(Occupational Employment Statistics)*
Biological Scientists 24308